THE WEATHER AND CIRCULATION OF MAY 1966

Warm and Dry in the West and Cool in the East

JAMES F. O'CONNOR

Weather Bureau, Environmental Science Services Administration, Washington, D.C.

1. HIGHLIGHTS

May was warm and dry in the western half of the 48 States, cold in the eastern half, and wet along the Gulf and Atlantic Coasts, reversing the pattern of May 1965 in many regions [1]. It was cold and wet in Alaska and relatively dry in Hawaii.

This May was the coldest on record at Flint, Mich., Rockford, Ill., Youngstown, Ohio, and Bridgeport, Conn. At Rockford, Ill., Fort Wayne, Ind., and Detroit, Mich., the average temperature for May was 7.7° F. below normal, more than twice the standard deviation for May. New records for the coldest day in May were established on May 10 or 11 by subfreezing temperatures throughout the Midwest and Northeast.

Record amounts of snow for May fell at Youngstown, Ohio (5.4 in.) and Burlington, Vt. (3.9 in.) on May 9, and at Dubuque, Iowa (3.1 in.) on May 11. Record 24-hr. amounts of rain for May fell at Madison, Wis. (3.64 in.) on May 23 and at Trenton, N.J. (2.68 in.) on May 19. The extreme drought along the Middle Atlantic and New England coasts was alleviated somewhat by heavy rains. In the Southeast, cloudy or rainy days occurred in near record numbers of up to 20 days (compared to a normal of about 9 rainy days), especially near the coast from Daytona Beach, Fla., to Wilmington, N.C. In Alaska, it was the wettest May on record at Juneau (6.33 in.) and King Salmon (2.40 in.).

Extreme dryness prevailed in May from the Pacific coast to the Central Plains, increasing the number of consecutive months of below normal precipitation to 6 or more in some places. It was the driest May on record at Concordia, Topeka, and Wichita, Kans., Wichita Falls, Tex., and Cheyenne, Wyo. While this dryness, added to April's dryness in certain areas during the critical period of spring plant growth, was threatening serious damage to wheat and other crops, some benefit accrued from the reduced number of severe local storms.

The warmest weather in the West, relative to normal, occurred in Nevada, where average monthly temperatures ranged to 6.8° F. above normal at Reno. On May 5 and 6, record high temperatures for so early in the season occurred in the Pacific Northwest, including 96° F. at Pendleton, Oreg.

2. MEAN CIRCULATION

Contrary to the usual seasonal trend, the mid-latitude westerlies (35° N.–55° N.) at 700 mb. in the western half of the hemisphere increased to an average speed of 9.2 m.p.s. in May, compared with a normal average of 7.2 m.p.s. This abnormal increase resulted from strengthened pressure gradients associated with widespread pressure (or 700-mb. height) falls at high latitudes, and rises at middle latitudes.

The greatest height falls occurred on the Asiatic side of the North Pole, in association with an intense vortex there (fig. 1). More significant for North America were the height falls (not shown because of pattern similarity to fig. 2) associated with deeper-than-normal troughs in the Gulf of Alaska and near the California coast, as well as in southeastern Canada and the Great Lakes region. The trough from the Great Lakes southward, identified with a negative height anomaly center of 160 ft. in figure 2, was well to the west of the normal trough location in May [2].

An abnormally strong high pressure system at sea level was centered over Baffin Island (fig. 3), far to the southeast of its more usual May location over the Arctic Ocean [2]. This feature was also reflected at 700 mb. by the blocking (positive) height anomaly center of 200 ft. north of Hudson Bay (fig. 2) and resulted from an eastward shift of the ridge from its usual position over western Canada in response to the deepening over Alaska and western Canada.

Pressure rises at middle latitudes in both Pacific and Atlantic resulted in abnormally strong oceanic anticyclones about 5° lat. north of normal and to the south of the abnormally deep cyclonic centers near Alaska and Iceland. This augmented out-of-phase relation between high and middle latitudes is clearly revealed by the contours of height departure from normal (fig. 2) and the mean sea level isobars (fig. 3).

The associated wind-speed analysis at 700 mb. (fig. 4) revealed a strong zonal jet axis on the average at mid-latitudes across the Pacific and Atlantic Oceans and north of its normal position. The maximum speed of 19 m.p.s. off Newfoundland was about 6 m.p.s. stronger than the normal maximum in that region and 9 m.p.s.

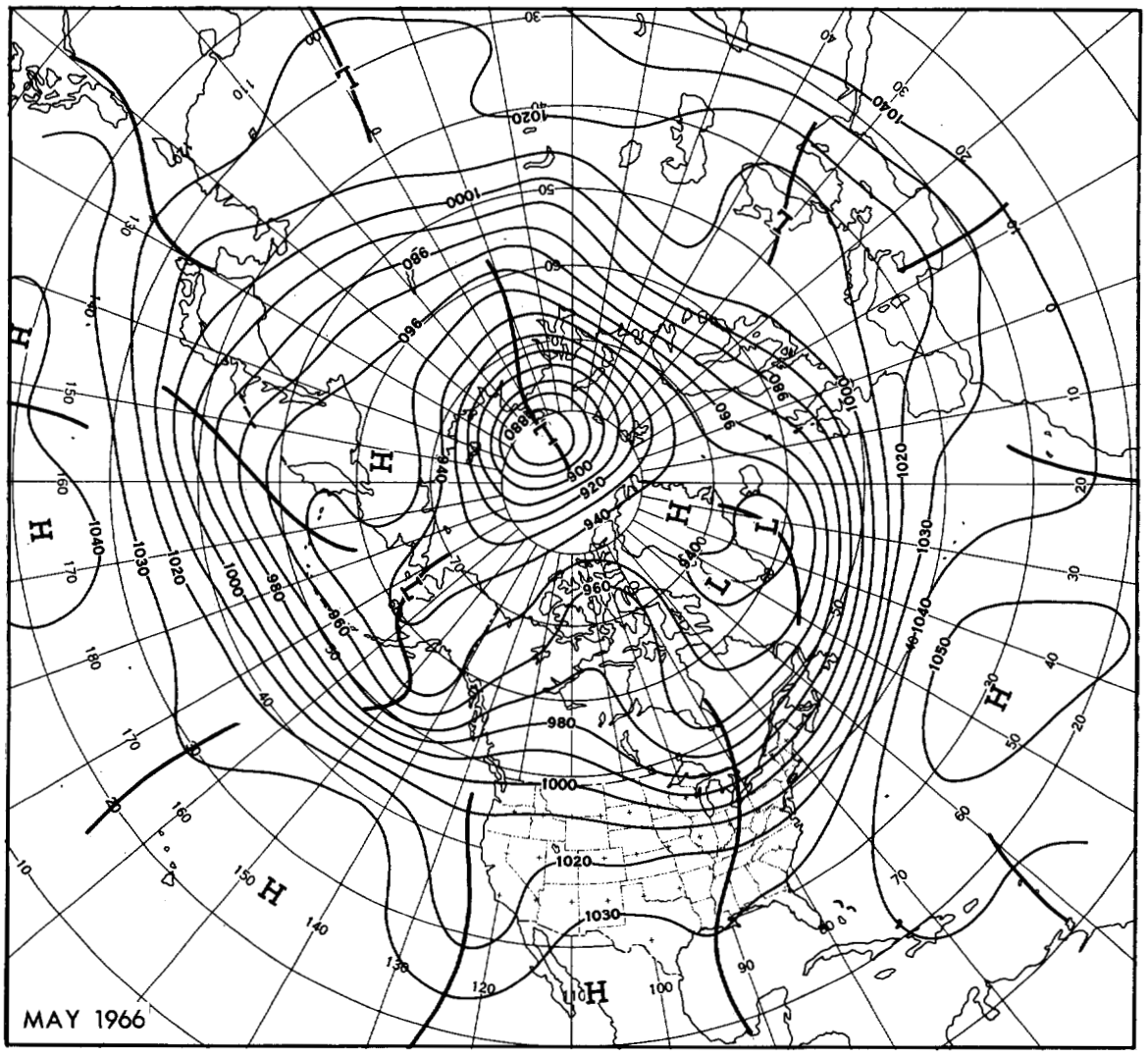


FIGURE 1.—Mean 700-mb. contours (tens of feet) for May 1966.

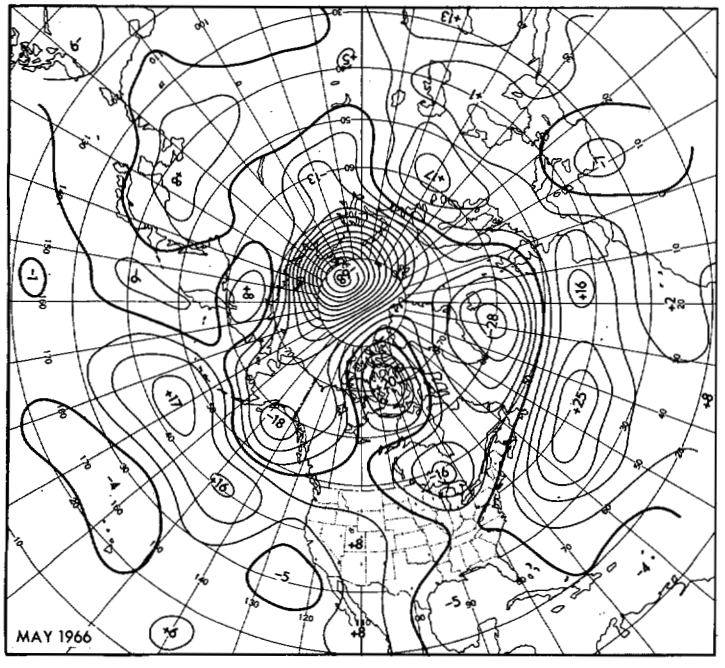


FIGURE 2.—Departure of mean 700-mb. heights from normal (tens of feet) for May 1966.

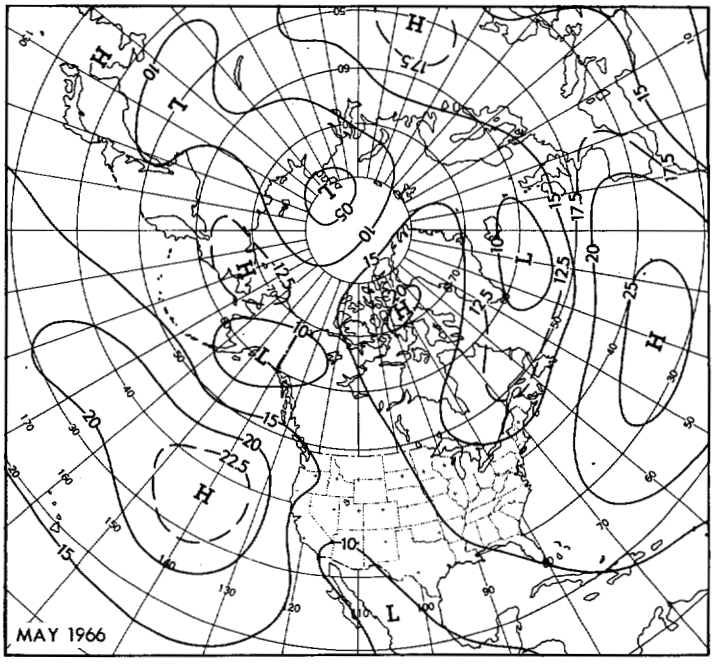


FIGURE 3.—Mean sea level isobars (units and tens of mb.) for May 1966.

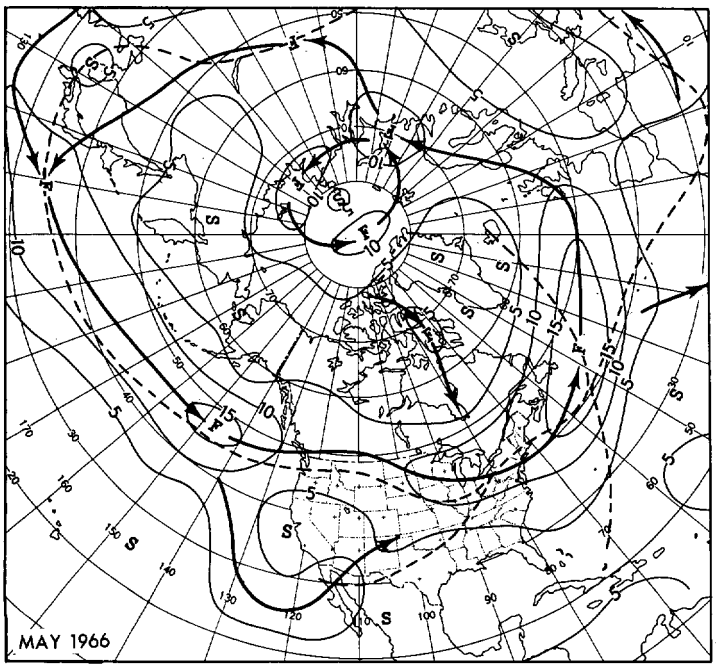


FIGURE 4.—Mean isotachs (m.p.s.) at 700 mb. for May 1966. Solid arrows are axes of maximum speed, dashed lines the normal axes.

stronger than the normal speed at the location of the May 1966 maximum.

At lower latitudes the mean troughs were generally sheared from their middle- and high-latitude counterparts by the strong mid-latitude westerlies. This was reflected in an increased tendency toward cutting-off of cyclonic centers at lower latitudes than usual. A tendency for resonance between lower-latitude cut-offs near Hawaii, California, the Gulf of Mexico, the Windward and Canary Islands, and the Mediterranean region is revealed by the monthly contours at 700 mb. (fig. 1) or their departures from normal (fig. 2).

3. TEMPERATURE

Unseasonably cool weather which had characterized the preceding month [3] continued during May over the eastern half of the country and parts of the Northern and Southern Plains (fig. 5). The coolest weather, relative to normal, which set new records in parts of the Midwest, was related to augmented northerly flow between the Great Lakes trough and the western ridge. Also of major importance in the maintenance of low temperatures was the strong blocking high pressure ridge from Greenland across Hudson Bay (fig. 3). This ridge and its extension into the Midwest and East reflected the prevailing anticyclone track from the eastern Canadian source of many of the cold air masses affecting the United States. An abnormally extensive snow cover in eastern Canada during most of the month helped maintain the coldness of the southward-moving polar air.

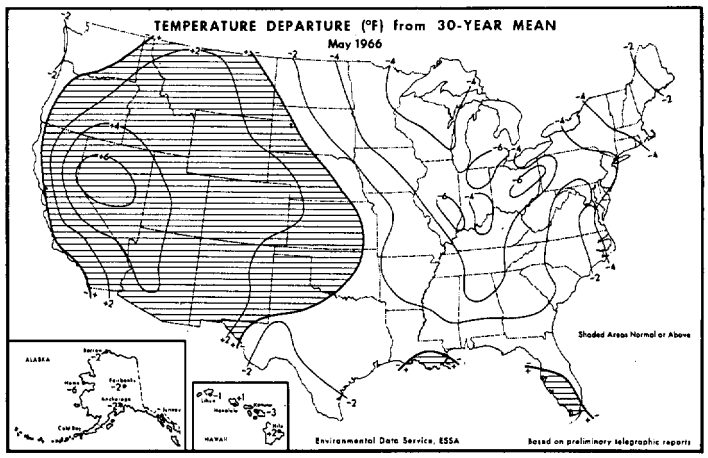


FIGURE 5.—Departure of average surface temperature from normal (°F.) for May 1966 (from [4]).

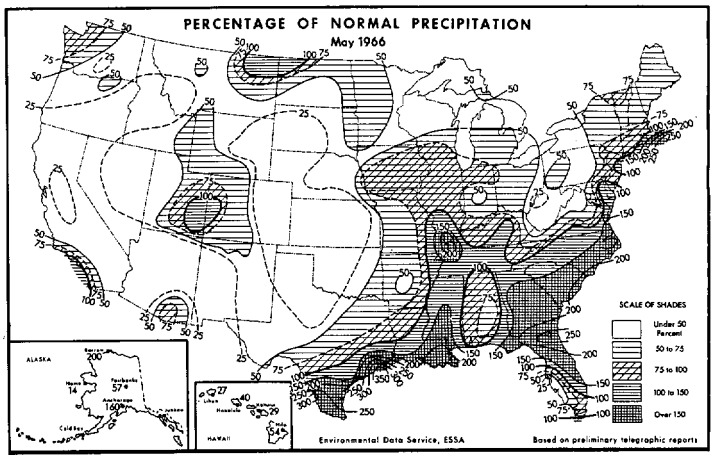
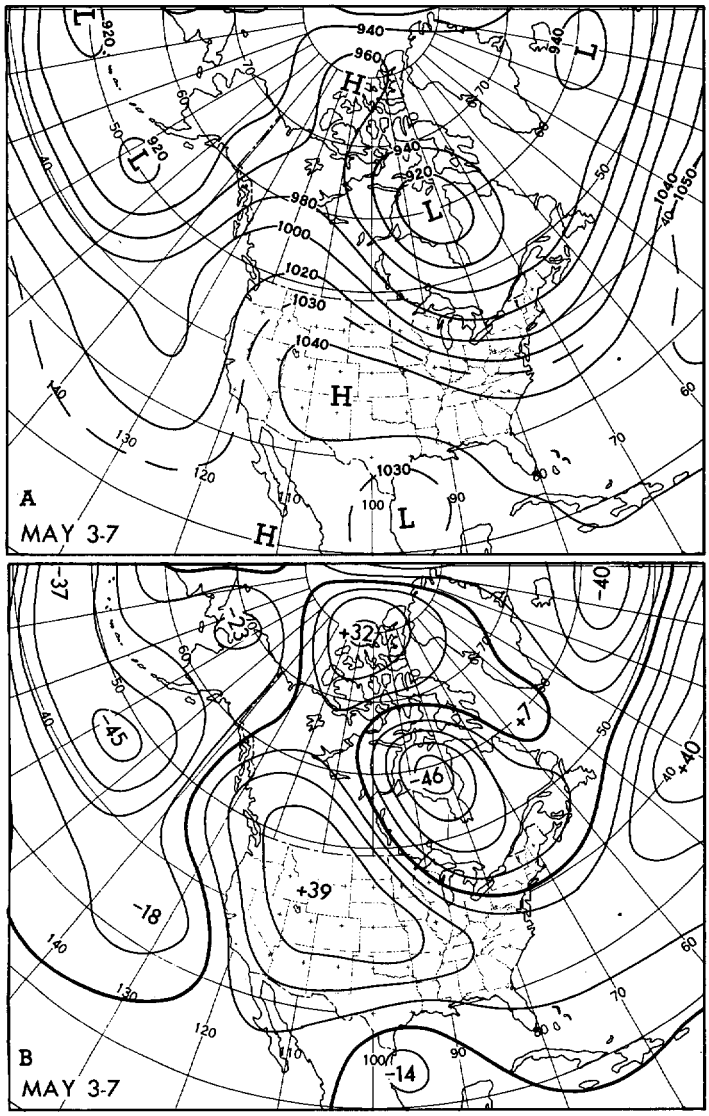


FIGURE 6.—Percentage of normal precipitation for May 1966 (from [4]).

Near the Middle Atlantic coast, temperatures were lower, relative to normal, than farther inland, because of the greater cloudiness and rainfall along the coast. Another contributing factor was the abnormally cold ocean surface which averaged as much as 11° F. below normal. The average anomalous geostrophic flow on the west side of the strong Atlantic High (implied by the contours of height departure from normal in fig. 2) favored a prevailing onshore drift of air from the cold water surface off the coast.

Most of the western half of the Nation warmed even more than is usual between April and May, reaching record temperature levels in parts of Nevada. The warmth was associated with the strong ridge over that region during most of the month, which, together with the deeper than normal trough off the California coast, provided a strong southerly transport of warm air from the warm source region over Mexico. This warmth was enhanced by subsidence favored by the anticyclonic flow over the Great Basin, and increased solar heating permitted by the excessive dryness which prevailed.



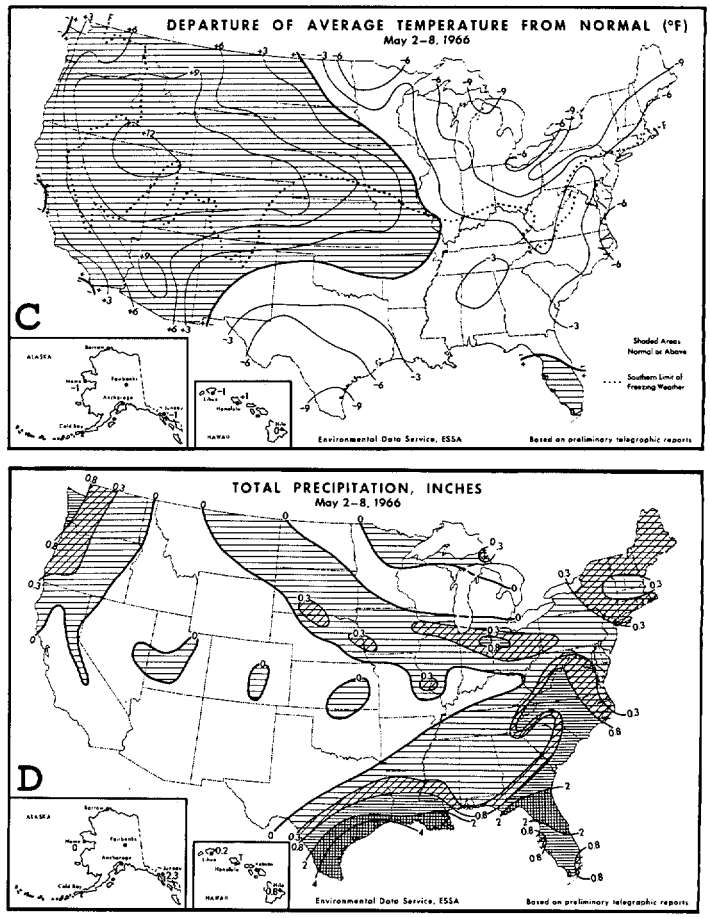


FIGURE 7.—(A) Mean 700-mb. contours and (B) 700-mb. height departures from normal (both in tens of feet) for May 3–7, 1966. (C) Departure of average surface temperature from normal (°F.) and (D) total precipitation (in.) for week of May 2–8, 1966 (from [4]).

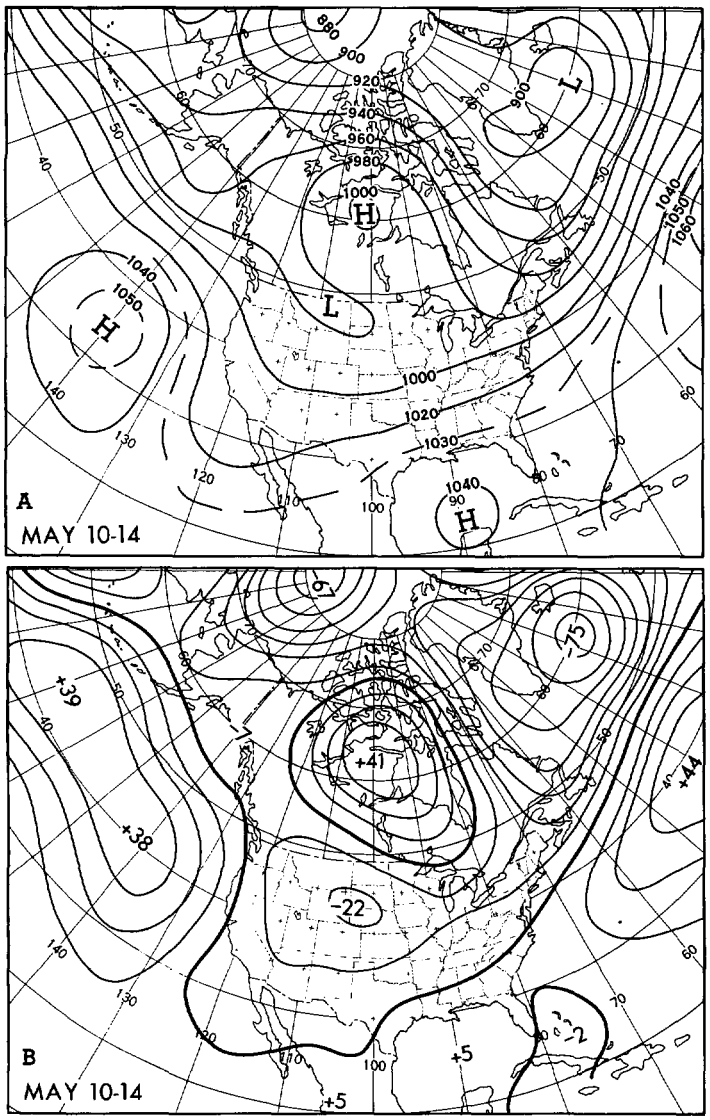
4. PRECIPITATION

Heavier than normal rainfall in the eastern part of the country (fig. 6) resulted from the west-of-normal location of the mean trough and its associated negative height anomaly from the Great Lakes to the lower Mississippi Valley, together with the abnormal strength of the Atlantic High. The enhanced northward flow of moist tropical air from the Gulf of Mexico and South Atlantic overran the cold air inland and augmented the lifting of moisture-laden air associated with disturbances south of the normal track, especially in the confluent flow over the Southeast (fig. 1). Along the Gulf coast, Lows periodically became cut-off at the southern part of the trough in the Gulf of Mexico; this resulted in excessive rains in some southern coastal areas.

The rather abrupt western edge of the moderate to heavy rain (fig. 6) coincided with the boundary or mean front between the warm air to the west and cool air to the east (fig. 5), suggesting the transition from downslope motion in the Central Plains to upslope motion over the low-level cold air in the Mississippi Valley.

The extreme dryness over a large part of the West was related to the prevalence of anticyclonic circulations which favored subsidence, both dynamic and topographic, and a scarcity of storms impinging on the west coast of the United States. The principal storm track from the Pacific (not shown) was far to the north, from the Gulf of Alaska across the Yukon, as reflected in the mean sea level map (fig. 3) and the northward displacement of the mean jet axis (fig. 4). The meager amounts of precipitation that occurred during the month in the West fell principally during the second week when a breakdown of anticyclonic circulation permitted the principal disturbances of the month to affect the northern Rockies and Plains.

Heavy precipitation fell in parts of Alaska, especially along the southern and southeastern coasts in the frequent storms associated with the deep center of action centered



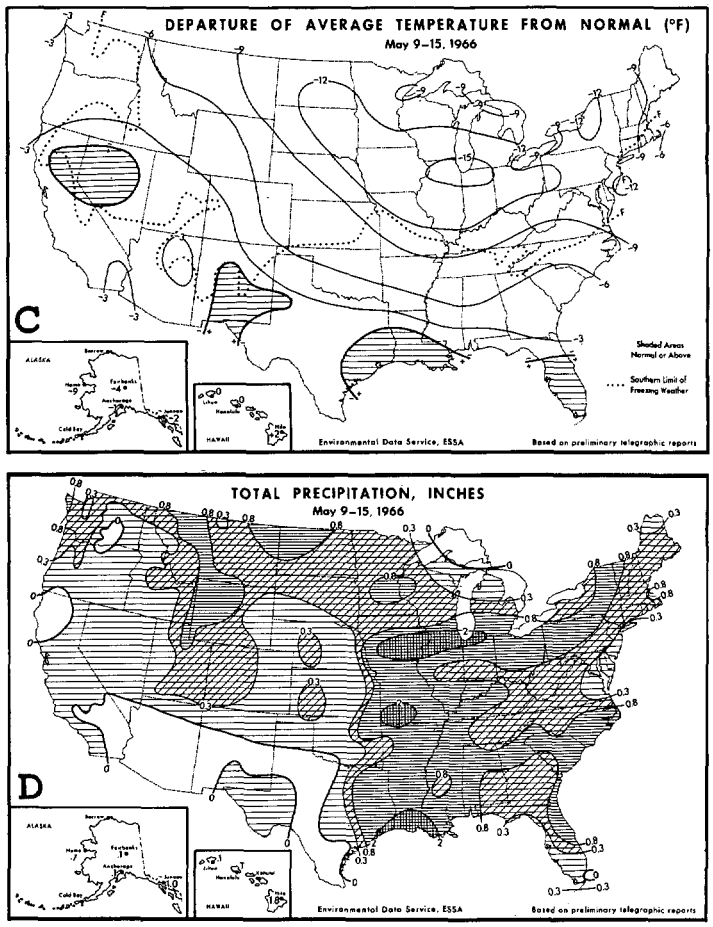


FIGURE 8.—Same as figure 7. (A) and (B) for May 10–14, 1966; (C) and (D) for week of May 9–15, 1966 (from [4]).

near Kodiak. In Hawaii, however, rainfall was generally less than normal, even though the Pacific High was stronger than normal, a condition which usually increases the trade winds and rainfall at windward sites. However, the zonal axis of the High shifted far enough (about 7° lat.) north of the normal location to permit cut-off cyclonic activity north of the Islands, which was accompanied by more westerly and drier flow than usual aloft.

5. WEEKLY WEATHER AND CIRCULATION

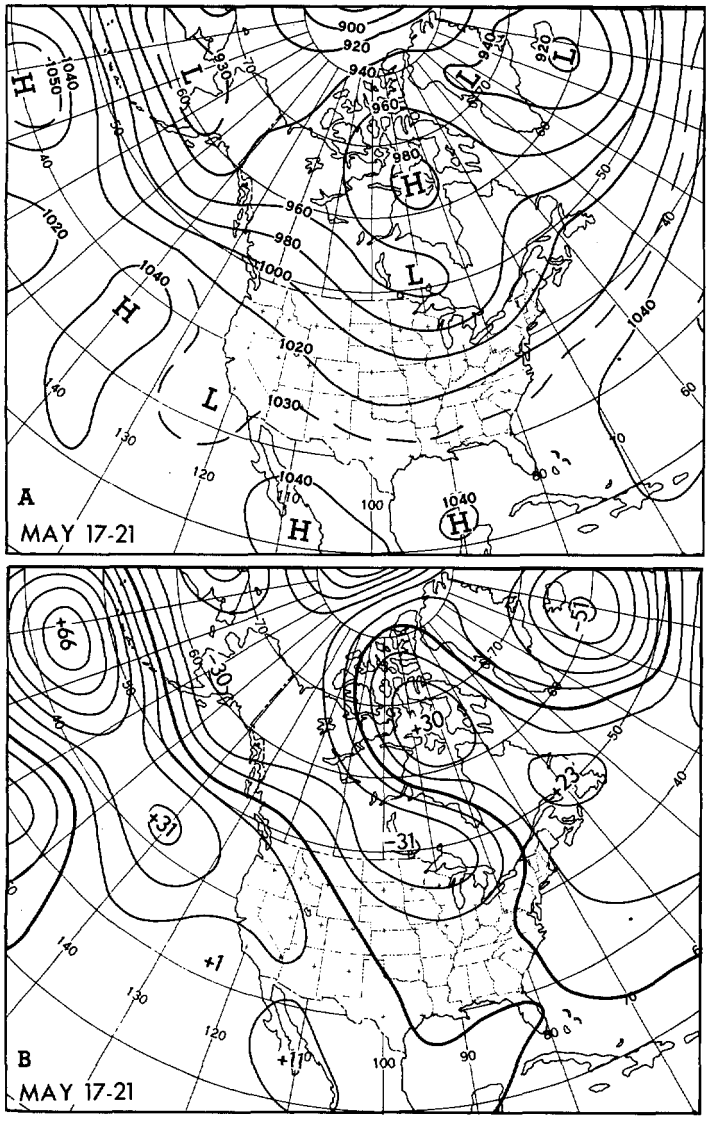
MAY 2–8, 1966

The prevailing circulation and departures from normal during the first week of May are approximated by the 5-day mean circulation for May 3–7 in figures 7A and 7B. This was the warmest week during May in the West (fig. 7C) associated with the strongest ridge development of the month. The extremely strong northwesterly flow across the Great Lakes resulted in record low daily minimum temperatures for May at Sault Ste. Marie, Mich. (18° F.) and Syracuse, N.Y. (25° F.) on May 7, and Burlington, Vt. (24° F.) on May 3.

A cut-off Low in the western Gulf of Mexico drenched the Texas Gulf coast for six days with rainfall totals of up to 9 in., and spread heavy rains into the eastern Gulf States later in the week (fig. 7D).

MAY 9–15, 1966

During the second week the western ridge was replaced by the deep trough previously off the Pacific coast (fig. 8A). At the same time a strong blocking High (410 ft. above normal, fig. 8B) replaced the deep vortex of the previous week over Hudson Bay. With 700-mb. heights below normal over almost the entire country, and moist southwesterly flow overrunning a strong cold surface High (not shown) centered near Lake Winnipeg, Canada, it was a cold, cloudy and wet week in most areas (figs. 8C and 8D).



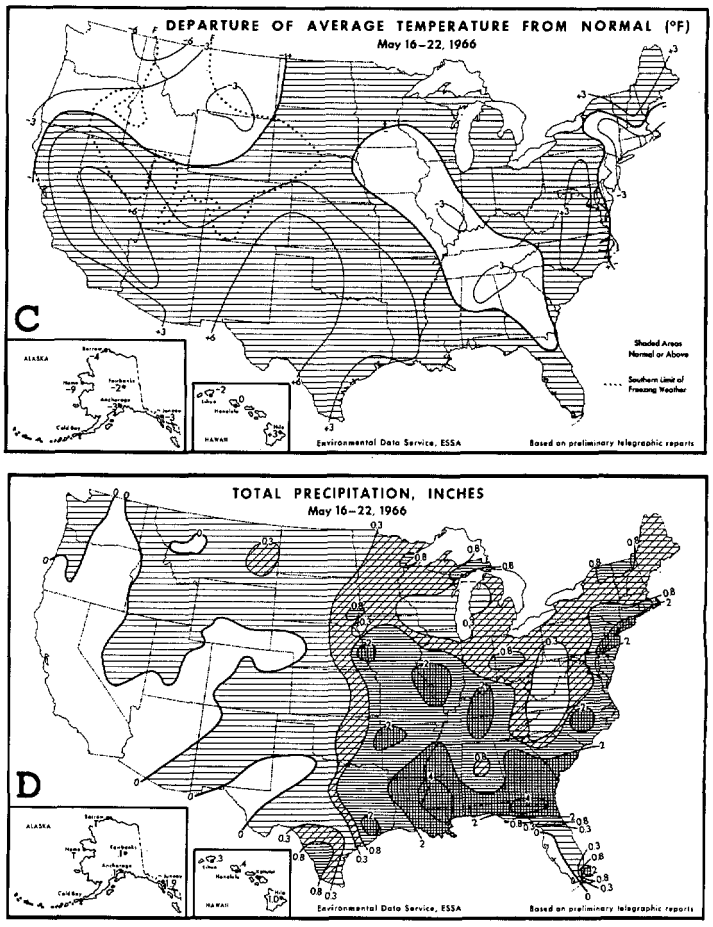


FIGURE 9.—Same as figure 7. (A) and (B) for May 17–21, 1966; (C) and (D) for week of May 16–22, 1966 (from [4]).

TABLE 1.—*Daily minimum temperature records established in May 1966*

City	Date	Temperature (° F.)
Green Bay, Wis	9	21
Milwaukee, Wis	10	21
Moline, Ill	10	26
Peoria, Ill	10	25
Rockford, Ill	10	24
Springfield, Ill	10	28
St. Louis, Mo	10	31
Alpena, Mich	2, 7	20
Detroit, Mich	10	25
Flint, Mich	10	22
Sault Ste. Marie, Mich	7	18
Indianapolis, Ind	10	28
Lexington, Ky	10	26
Cincinnati, Ohio	10	28
Cleveland, Ohio	10	25
Youngstown, Ohio	10	24
Elkins, W. Va	10	20
Huntington, W. Va	10	27
Parkersburg, W. Va	10	28
Lynchburg, Va	11	31
Syracuse, N. Y	7	25
Harrisburg, Pa	11	31
Philadelphia, Pa	11	28
Bridgeport, Conn	10	31
Burlington, Vt	3	24

Widespread severe freezes from the Midwest to the Mid-Atlantic coast established new records for the lowest May temperatures at the cities shown in table 1, and caused widespread damage to fruit and crops as far south as Tennessee and North Carolina.

Moderate to heavy precipitation occurred over almost the entire 48 States during this week. Record heavy snows fell on May 9 and 11 at the cities mentioned earlier (section 1) associated with storms forced south of the normal track by the strong blocking High over south-central Canada. Flooding rains of 5.29 in. fell on the Texas upper coast on May 13, and the northeast drought area received more beneficial rains for the 3d or 4th consecutive week.

MAY 16–22, 1966

In the third week of May the blocking High in Canada shifted eastward to Baffin Island (fig. 9A) and 700-mb.

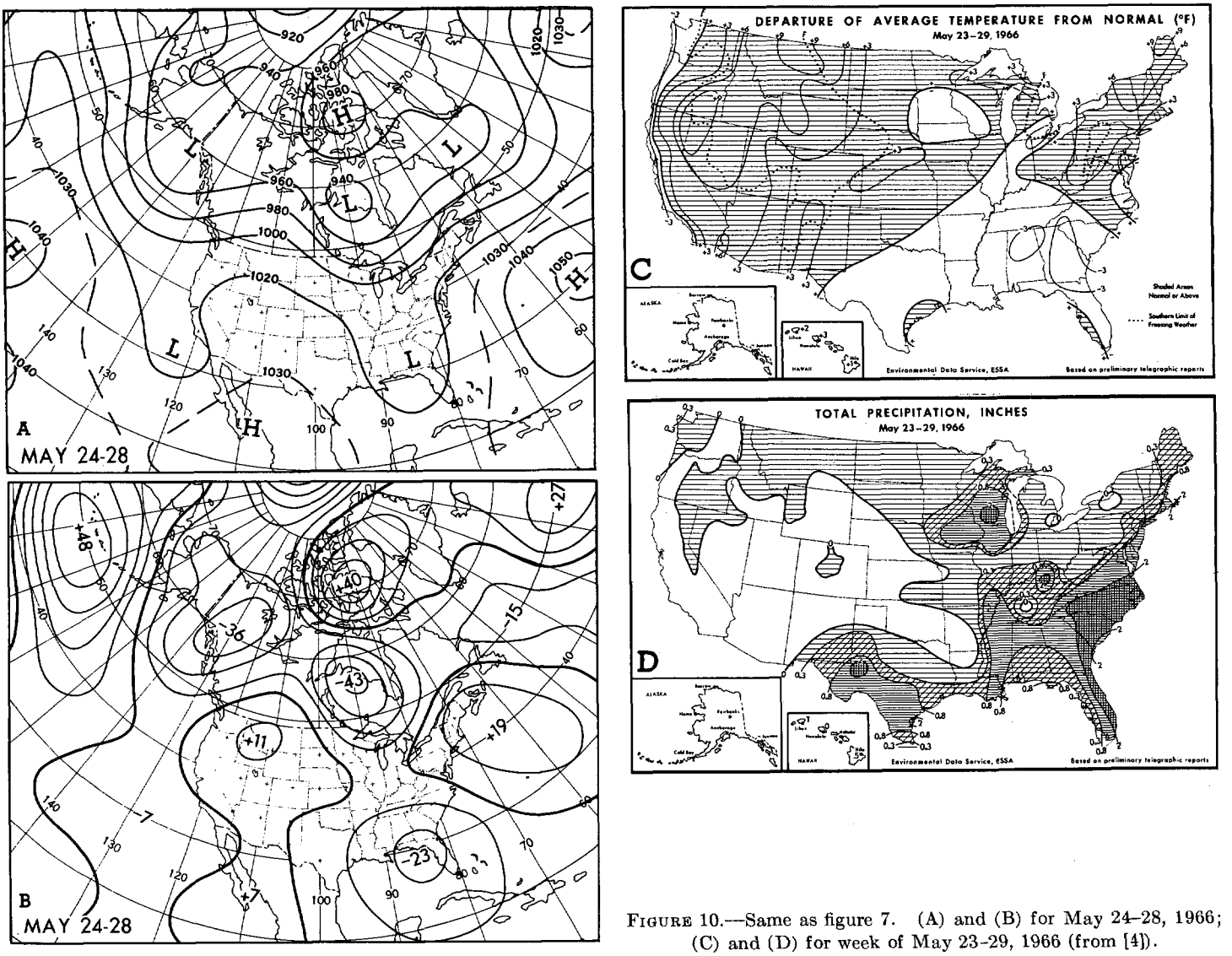


FIGURE 10.—Same as figure 7. (A) and (B) for May 24–28, 1966; (C) and (D) for week of May 23-29, 1966 (from [4]).

heights rose over the western half of the United States (fig. 9B) as the trough shifted eastward to the Mississippi Valley. At sea level (not shown) a mean Low near Lake Winnipeg, Canada, replaced the blocking High of the previous week. This change in circulation resulted in marked warming, except in the Pacific Northwest (fig. 9C), from the previous week's record cold weather east of the Continental Divide (fig. 8C).

Moderate to heavy rains fell in the eastern half of the country (fig. 9D), associated with two migratory troughs which set off widespread showers and locally heavy downpours in the moist tropical air which was brought northward from the Gulf of Mexico by strong southerly flow on the west side of the strong Atlantic High. Perhaps most beneficial were the very heavy rains along the southern New England and Atlantic coasts, the location of the most extreme drought of recent years.

MAY 23–29, 1966

In the fourth week, a trough returned to the eastern Pacific and a ridge to the western United States (fig. 10A), a circulation pattern similar to that of the first week. However, the East this week was under the influence of a strong Atlantic high cell located much closer to the coast than usual, and a cut-off Low in the eastern Gulf region identified with a strong negative height anomaly center (fig. 10B).

While the West and Central States were warmer than normal in agreement with the strength of the western ridge (fig. 10C), the warmth in the Northeast continued from the previous week in connection with the strong western Atlantic ridge. However, the Northeast turned much cooler in the last few days of May, when an amplification of the upper flow pattern led to another strong

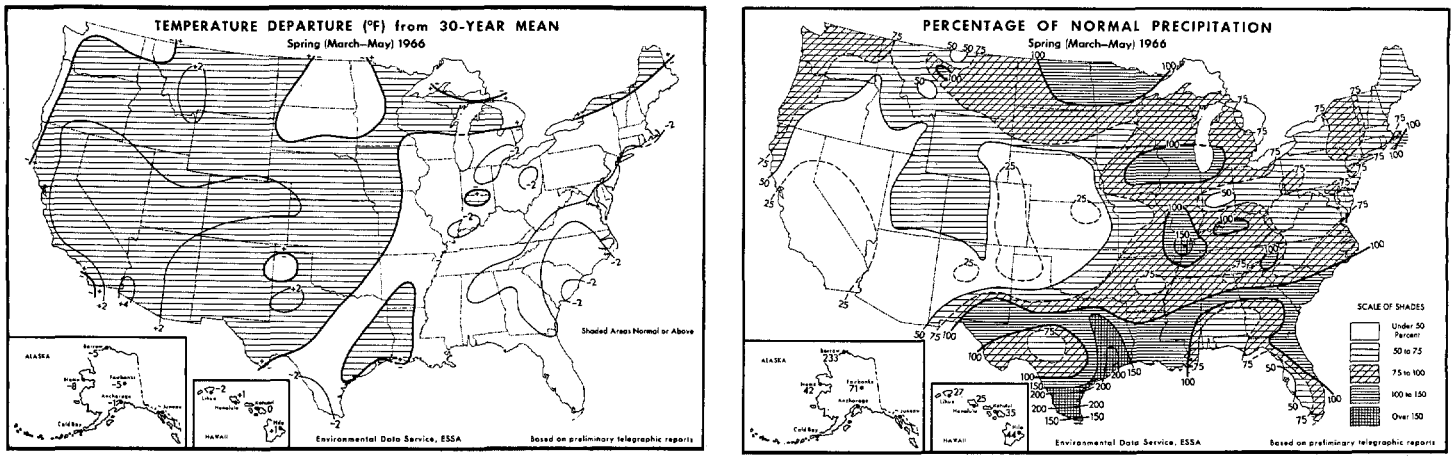


FIGURE 11.—(Left) Departure of average surface temperature from normal (°F.), and (Right) percentage of normal precipitation, for spring (March–May) 1966 (from [4]).

outbreak of cold air from Hudson Bay, which dropped temperatures to freezing and below, for the lowest readings so late in the season in some localities.

Heavy rainfall accompanied a frontal passage in the Midwest on May 23, including a record 3.64 in. in 24 hr. at Madison, Wis. In the Southeast, rains occurred almost daily from a cut-off Low, and spread northward later in the week, as the upper flow amplified, into the drought areas of the Atlantic coast. Nantucket, Mass. received 2.66 in. on May 28. Parts of West Texas also received heavy showers almost daily from May 26 to 29 (fig. 10D).

6. SPRING 1966

The spring months of March–May 1966 were warm and dry in the West and central Great Plains (fig. 11) associated with a strong ridge over the Rocky Mountains. This weather was in sharp contrast to the spring of 1965 when cool weather prevailed in the West with very heavy precipitation in the Southwest and North Central States. At that time the ridge was located off the Pacific coast and a trough extended from the Southwestern States to the North Central States associated with a series of vigorous storms along that general track. The trough this spring was much farther east, near the Mississippi Valley, a position which favored above normal precipitation in the Midwest and South.

The Northeast was generally drier than normal in spring 1966, as it was in the year previous, but precipitation totals closer to the normal in 1966 resulted in improved conditions in the critical drought areas of the upper Atlantic coast.

Although no official tabulations are as yet available, severe local weather activity appeared to be less frequent than usual, in agreement with the reduced trough activity in the West.

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